HYDROGEL CONTACT LENS

BACKGROUND OF THE INVENTION

The present invention relates to a soft plastic contact lens which is most useful in correcting visual deficiencies in the eye and more particularly to a contact lens of an hydrophilic, soft ophthalmic plastic material commonly known as gel lens material which not only enhances visual resolution in presbyopic ametropia but also is effective in pre-presbyopic ametropia.

During the last twenty-five years hard contact lenses have become effective therapeutic devices for the treatment of ametropia with capabilities far in excess of regular ophthalmic lenses. Although their use as a cosmetic replacement for regular ophthalmic lenses is the primary reason for their increased utilisation, they are, in fact, more effective in the treatment of most cases of high ametropia, anisometropia and irregular astigmatism than conventional spectacles.

In recent years their use has significantly increased and a demand for their wider application is manifest, especially so among presbyopic patients who have been wearing contact lenses for the last twenty or more years. These patients are now at the age where they require supplemental lens power over and above their contact lens correction in order to maintain normal vision function at near distances in the order of 13–16 inches. Many types of bifocal contact lenses have been designed and fitted with extremely limited success and acceptance. The simplest solution has been the use of spectacles for near tasks in conjunction with continuing contact lens wear and, in many cases, this has led to the abandonment of both in favour of regular ophthalmic bifocal lenses, with their inherent limitations. Regular bifocal lenses are rather restrictive on head and eye movements and therefore their value is reduced in many occupations. Development of contact lenses useful for both near and far distances has been long sought after.

Soft, hydrophilic or hydrated gel, ophthalmic plastic materials have been developed within the last ten to fifteen years and these materials are being used for contact lenses but no really satisfactory multifocal contact lens of this soft material has so far been produced.

Spherical aberration in the eye has been reduced in recent years by the use of hard plastic spectacle lenses having a front aspheric surface, such as for example in the Bausch & Lomb, American Optical Company, and Orma (trade mark) aspheric acrylic spectacle bifocal lenses used mainly in aphakia therapy. They improve resolution but are similar to regular bifocal lenses. More recently such a construction has been used in the Panofocal (trade mark) hard contact lens for the correction of ocular astigmatism.

In the Wichterle U.S. Pat. Nos. 2,976,576; 3,361,858; 3,408,429; 3,496,254; 3,497,577 and 3,499,862 methods for cutting and producing hydrophilic soft contact lenses are disclosed. Furthermore, in the Seiderman U.S. Pat. No. 3,503,942 a hydrophilic plastic contact lens is disclosed of a specific composition. Soft contact lenses have been developed which are effective in correcting astigmatism in the prepresbyopic eye. They are of toroidal but not aspheric design. However, in none of these patents is a soft contact lens disclosed, fitted to the wearer, which alleviates presbyopic ametropia.

BRIEF SUMMARY OF THE INVENTION

A soft, flexible, hydrophilic contact lens configuration has now been discovered which is effective in correcting vision for near and intermediate distances and for infinity.

The invention is directed to a novel hydrophilic contact lens having a special aspheric outer surface in which the radius of curvature, expressed in polar coordinates is $\rho=R+kR\ (1-\cos\theta)/(1+\cos\theta)$. The value of R is determined by the patient's ametropia and, for the presbyopic patient, additionally by the amount of presbyopic addition. For the prepresbyopic patient, the value of R is determined to provide correction for the most hyperopic (or least myopic) power meridian of the ametropia. For the presbyopic patient, the value of R is determined to provide the power necessary to correct the most hyperopic (or least myopic) power meridian of the ametropia, as above, plus approximately one-half of the presbyopic addition of the patient.

The k value, on the other hand, is primarily a function of the hydrophilic lens material and is determined empirically within the range 0.005 to 0.1. However, in fitting a patient, slight change in the empirical k value may be required in order to achieve equal (20/20 or better) acuity for distance and near vision.

It is an object of the present invention to produce a novel hydrated gel contact lens, fitted to the wearer, which alleviates presbyopia and simultaneously corrects the ametropia while providing heretofore unreached new levels of ocular compatability and patient acceptance.

Another object of the invention is to produce a novel hydrated gel contact lens which effectively alleviates astigmatism for the prepresbyopic as well as the presbyopic patient.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. 1 is a diagrammatic representation of a lens embodying the invention located on a wearer, and

FIG. 2 is a diagrammatic representation of the tracing of light rays through a lens embodying the invention and fitted on a wearer.

DETAILED DESCRIPTION OF THE INVENTION

The contact lens of this invention, as fitted to a wearer, is fabricated of an hydrophilic, soft, pliable, opthalmic plastic and it has an aspheric convex outer surface of special configuration. The optic zone or aperture of the lens in the dehydrated state extends over an angle 2θ of about 70°. The aspheric surface is defined by the equation $\rho=R+E'$ where R is the radius of curvature at the center of the lens, and E' is an asphericity term kE where $E=R(1-\cos\theta)/(1+\cos\theta)$ and k is an eccentricity constant chosen within the range 0.005 to 0.1.

In polar coordinates, then, the equation for the center surface of the lens is $\rho=R+kR(1-\cos\theta)/(1+\cos\theta)$, from which it will be evident that when k=0 the surface is spherical whereas when k=1 the surface is a parabaloid. The k value range of this invention (k=0.005 to 0.1) results in an ellipsoidal surface near that limit (k=0) where the surface is spherical.